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(54) **SOLID-STATE IMAGING APPARATUS AND METHOD OF MANUFACTURING THE SAME**

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H01L 27/146 (2006.01)
H01L 23/00 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 27/14623*** (2013.01); ***H01L 24/97*** (2013.01); ***H01L 27/14618*** (2013.01); *H01L 2224/48091* (2013.01); *H01L 2224/48227* (2013.01); *H01L 2224/48465* (2013.01); *H01L 2224/49175* (2013.01); *H01L 2924/19105* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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U.S. Appl. No. 13/357,883, filed Jan. 25, 2012, Iwafuchi, rt al.

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(57) **ABSTRACT**

A solid-state imaging apparatus includes: an imaging section having a light-receiving portion for receiving light from an object to image the object; and a substrate on which the imaging section is disposed, wherein a predetermined member provided on the substrate in the neighborhood of the light receiving portion is partially or entirely coated in black.

6 Claims, 8 Drawing Sheets

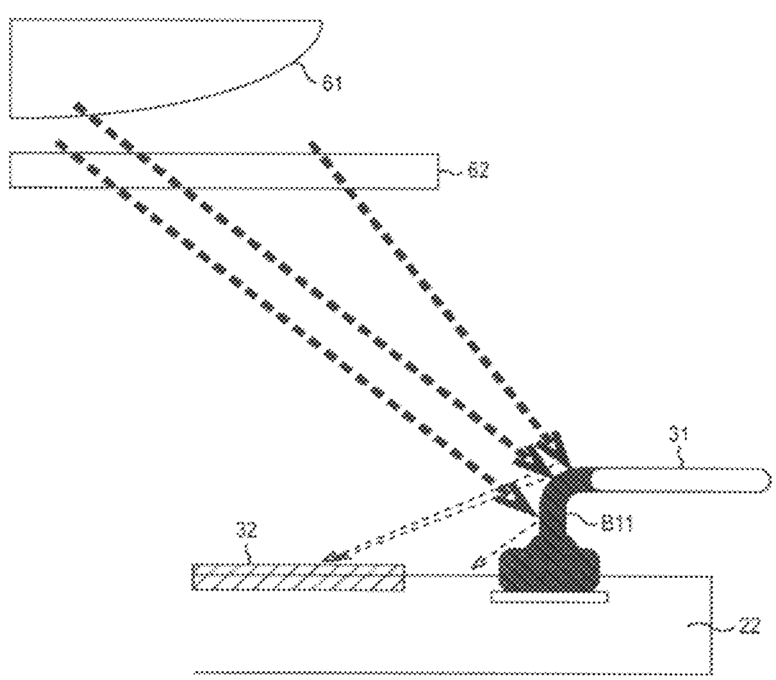


FIG.1

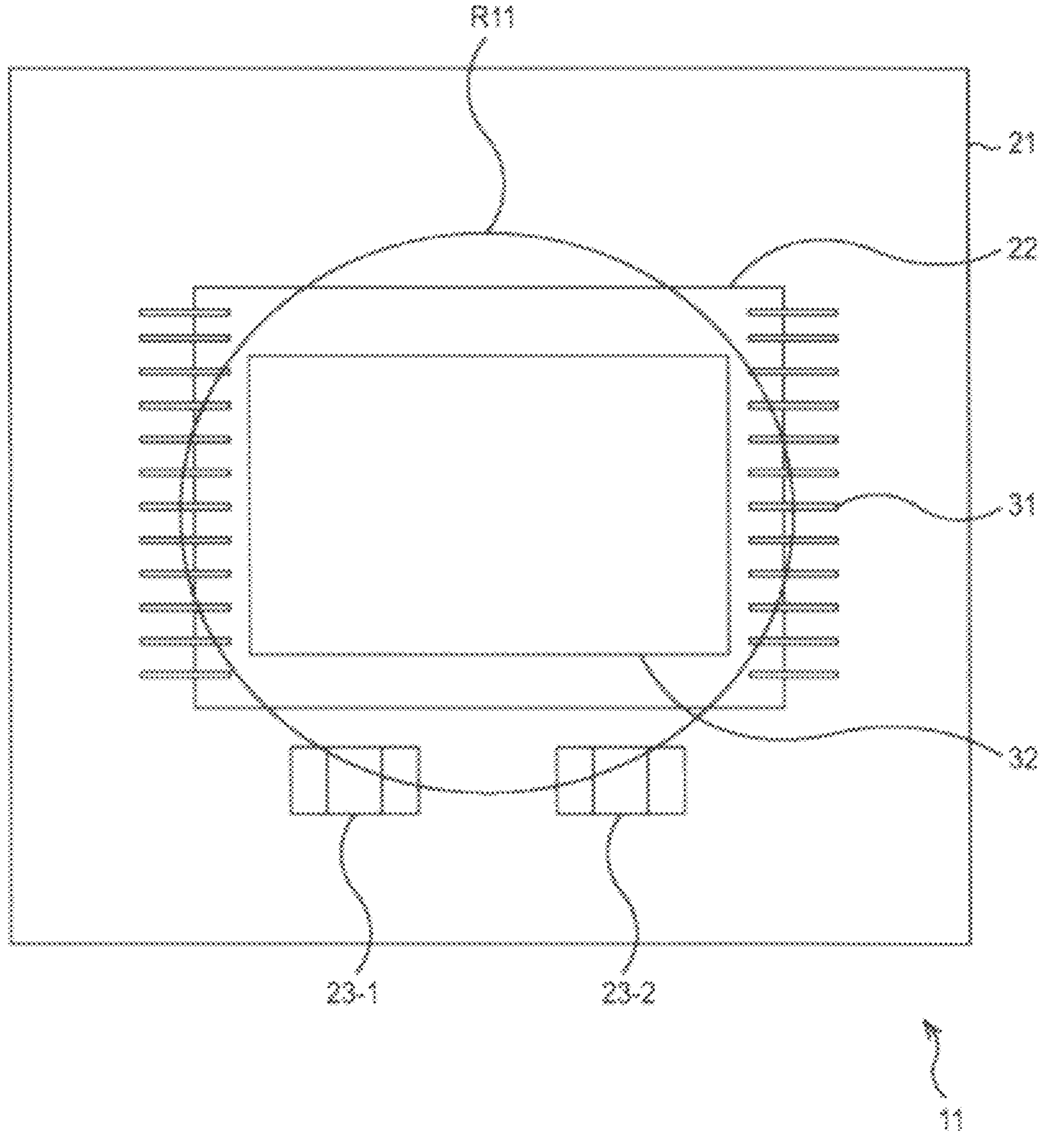


FIG.2

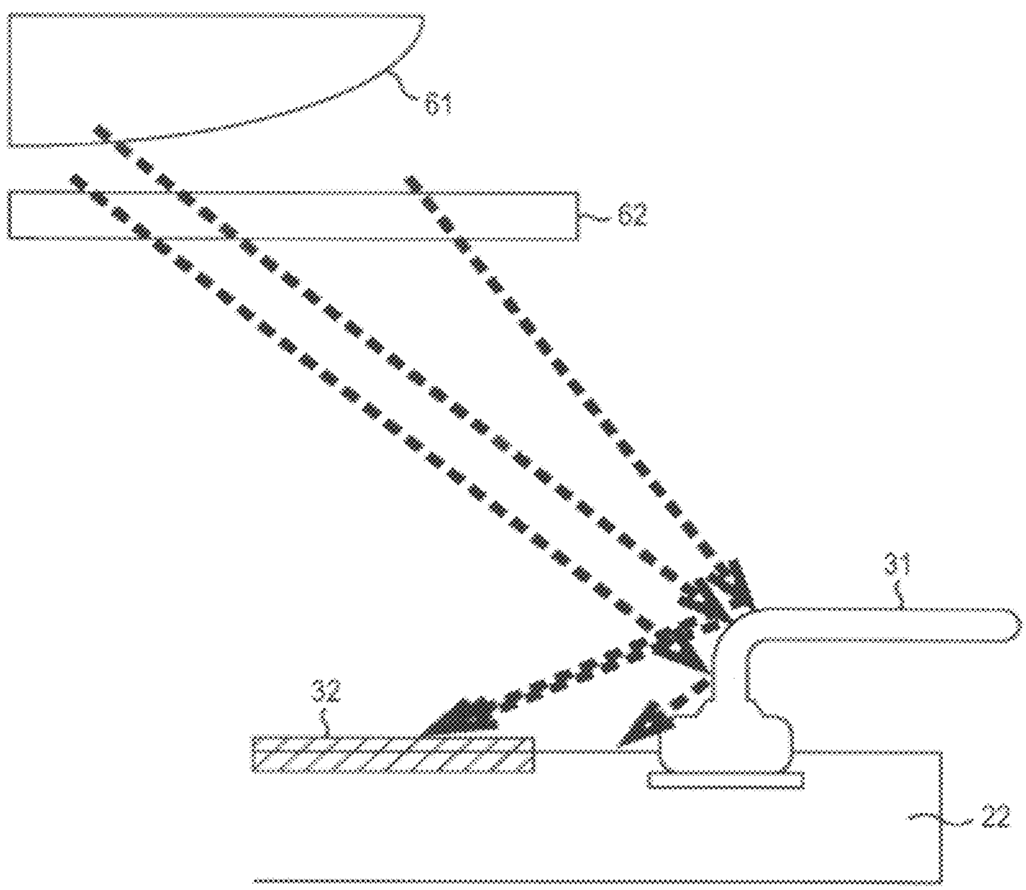


FIG. 3

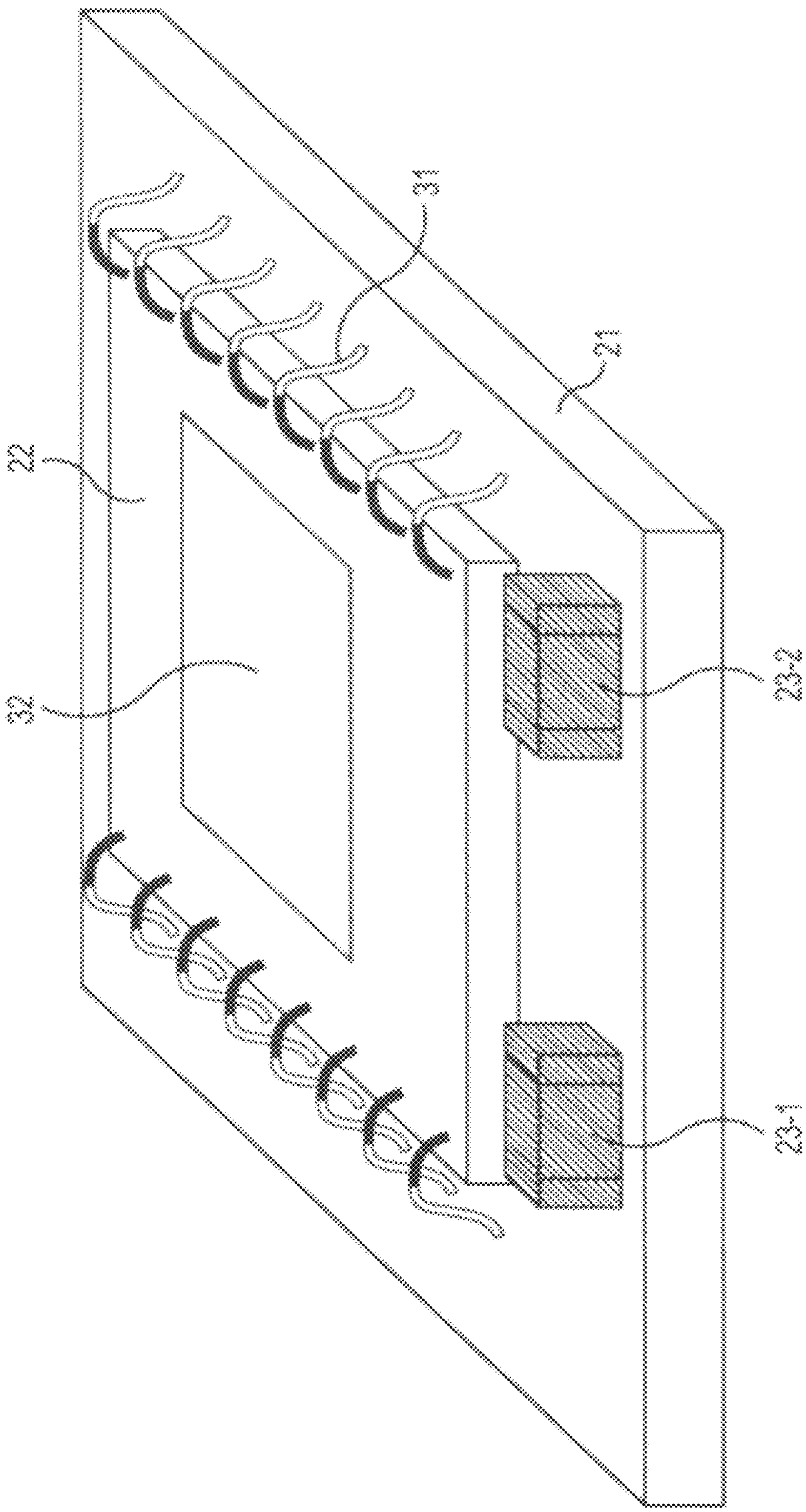


FIG.4

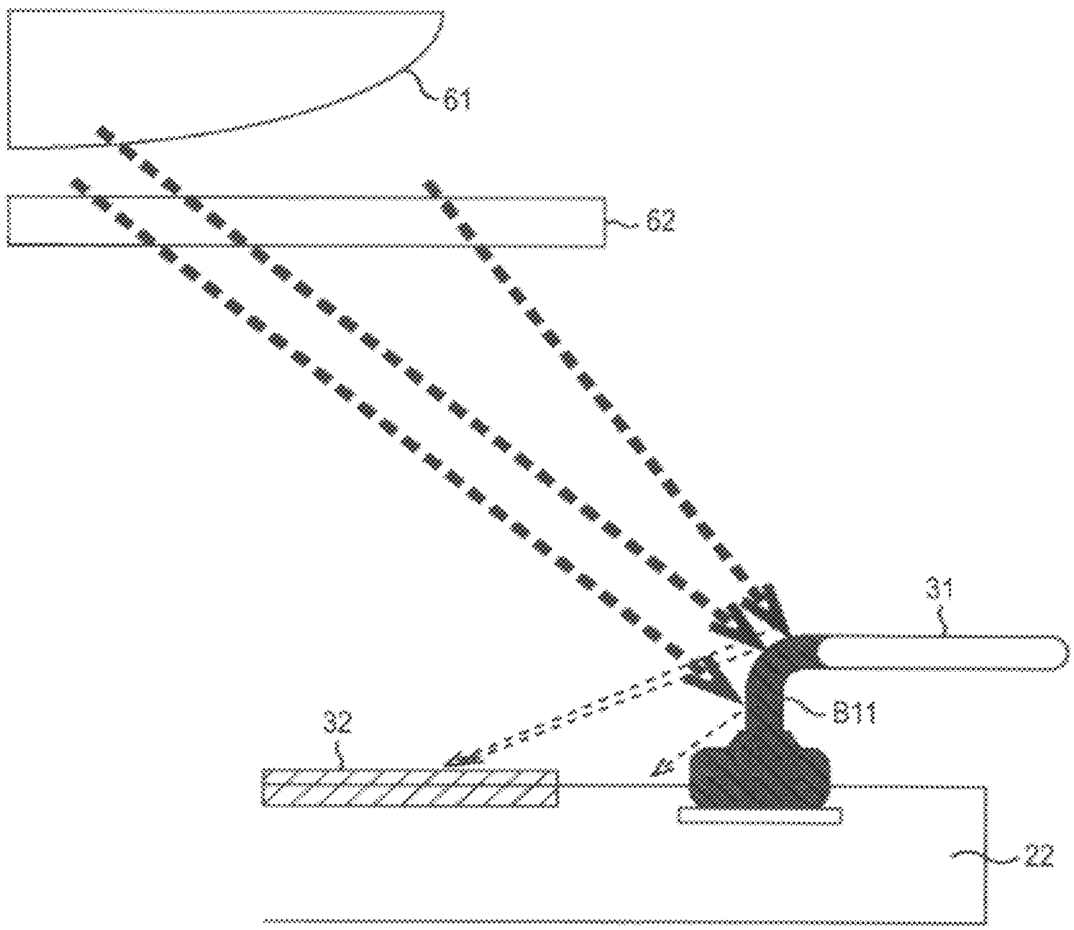


FIG. 5

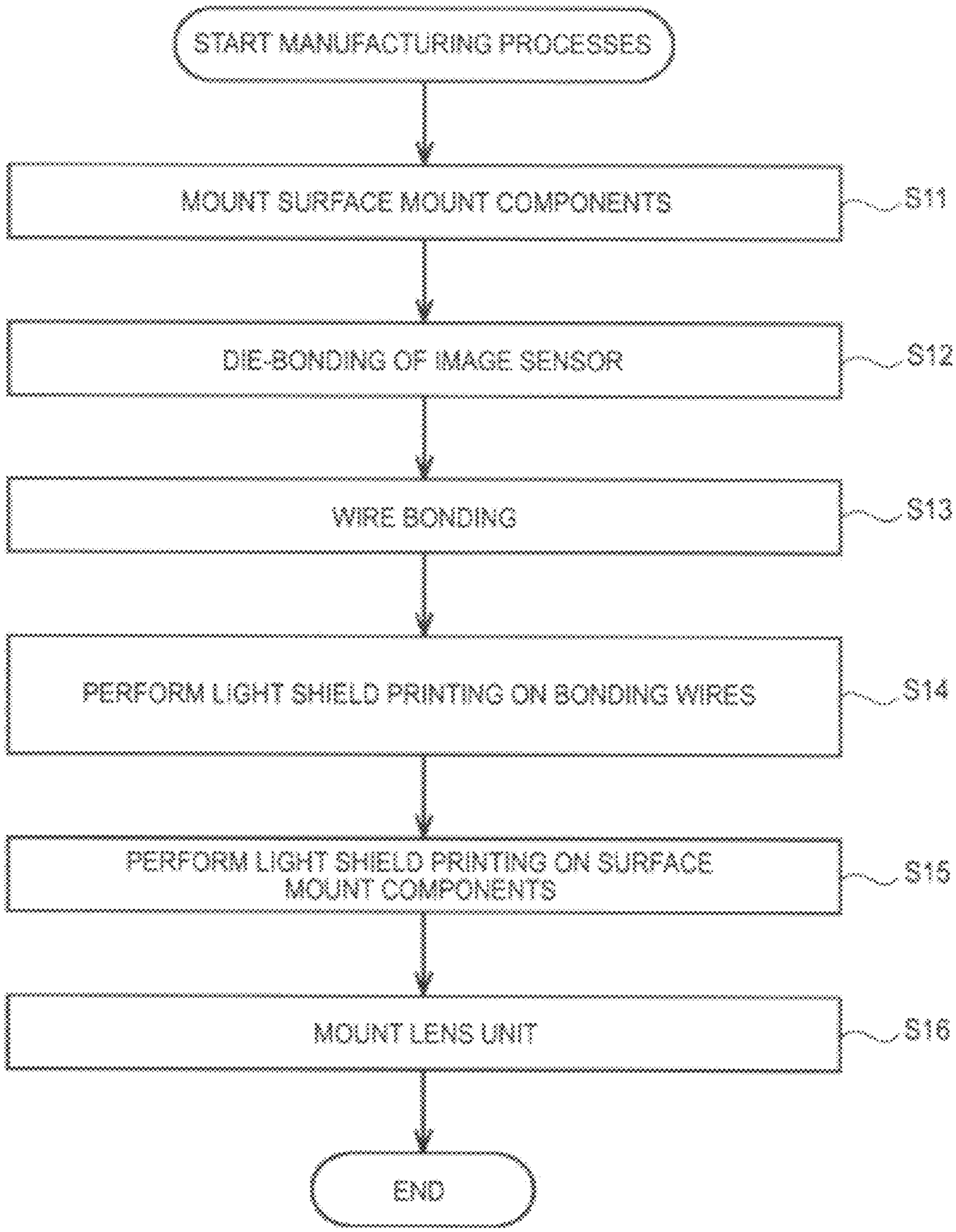

START MANUFACTURING PROCESSES
MOUNT SURFACE MOUNT COMPONENTS
S11
DIE-BONDING OF IMAGE SENSOR
S12
WIRE BONDING
S13
PERFORM LIGHT SHIELD PRINTING ON BONDING WIRES
S14
PERFORM LIGHT SHIELD PRINTING ON SURFACE MOUNT COMPONENTS
S15
MOUNT LENS UNIT
S16
END

FIG.6

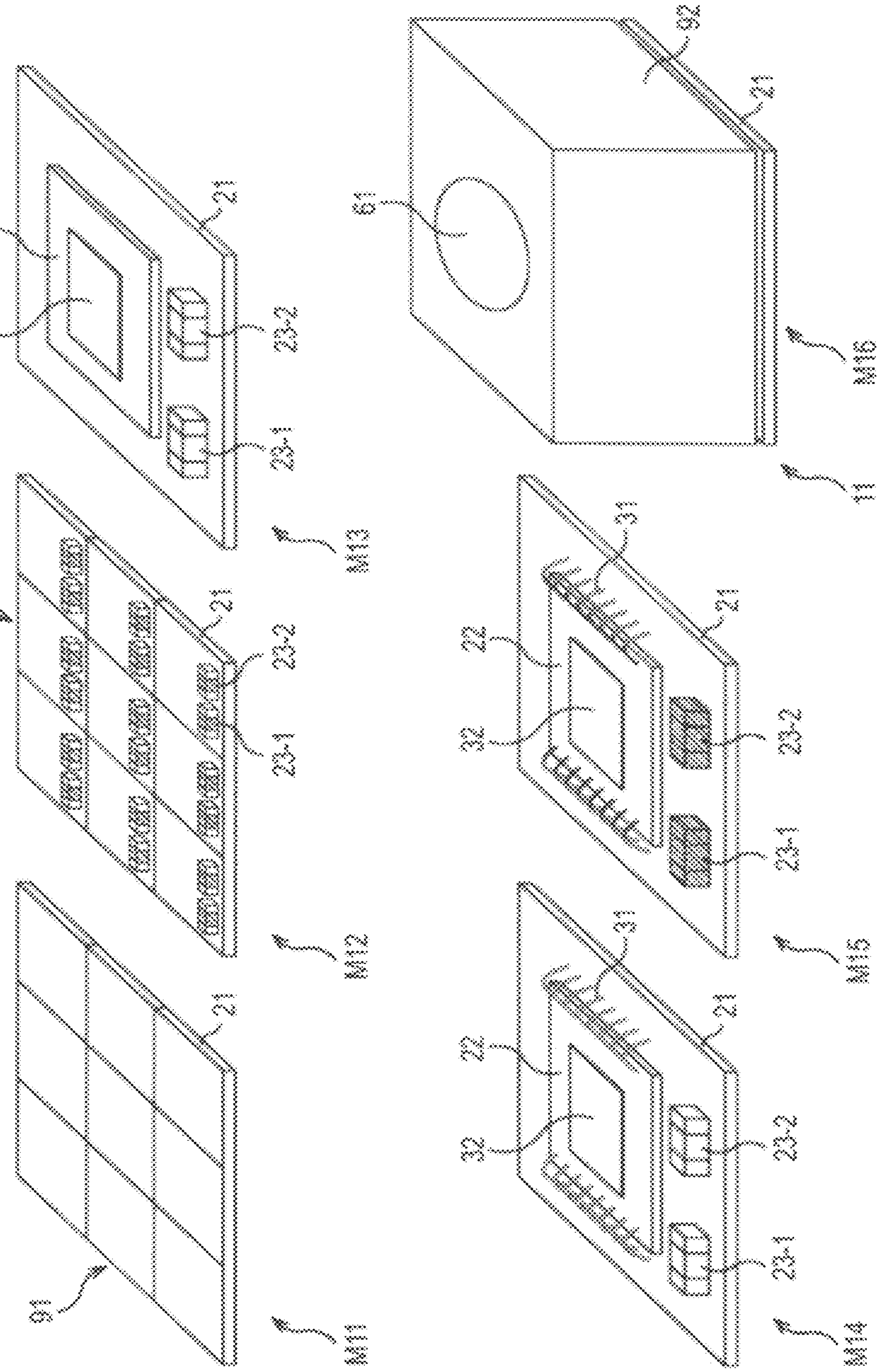

91
21
M11
91
23-1
23-2
21
M12
32
22
21
23-1
23-2
M13
32
22
31
21
23-1
23-2
M14
32
22
31
21
23-1
23-2
M15
61
92
21
11
M16

FIG.7

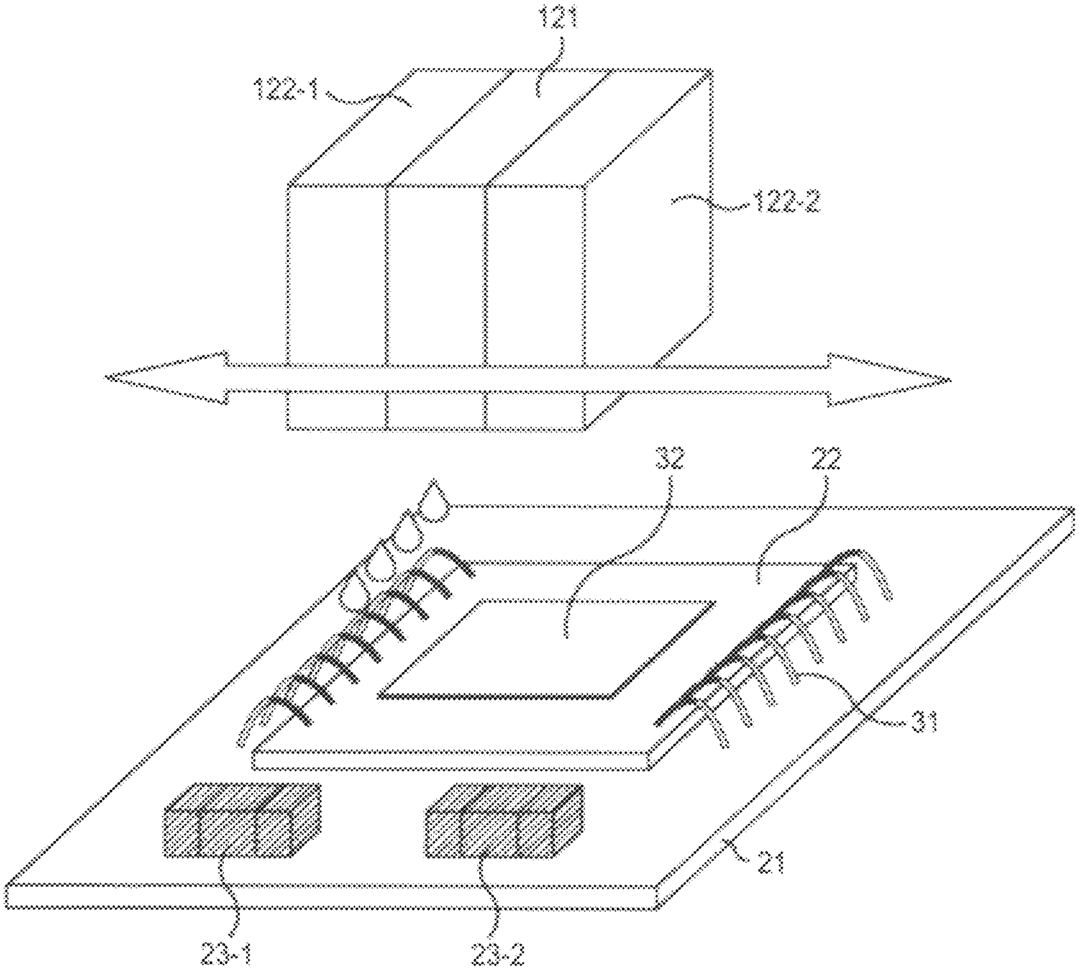
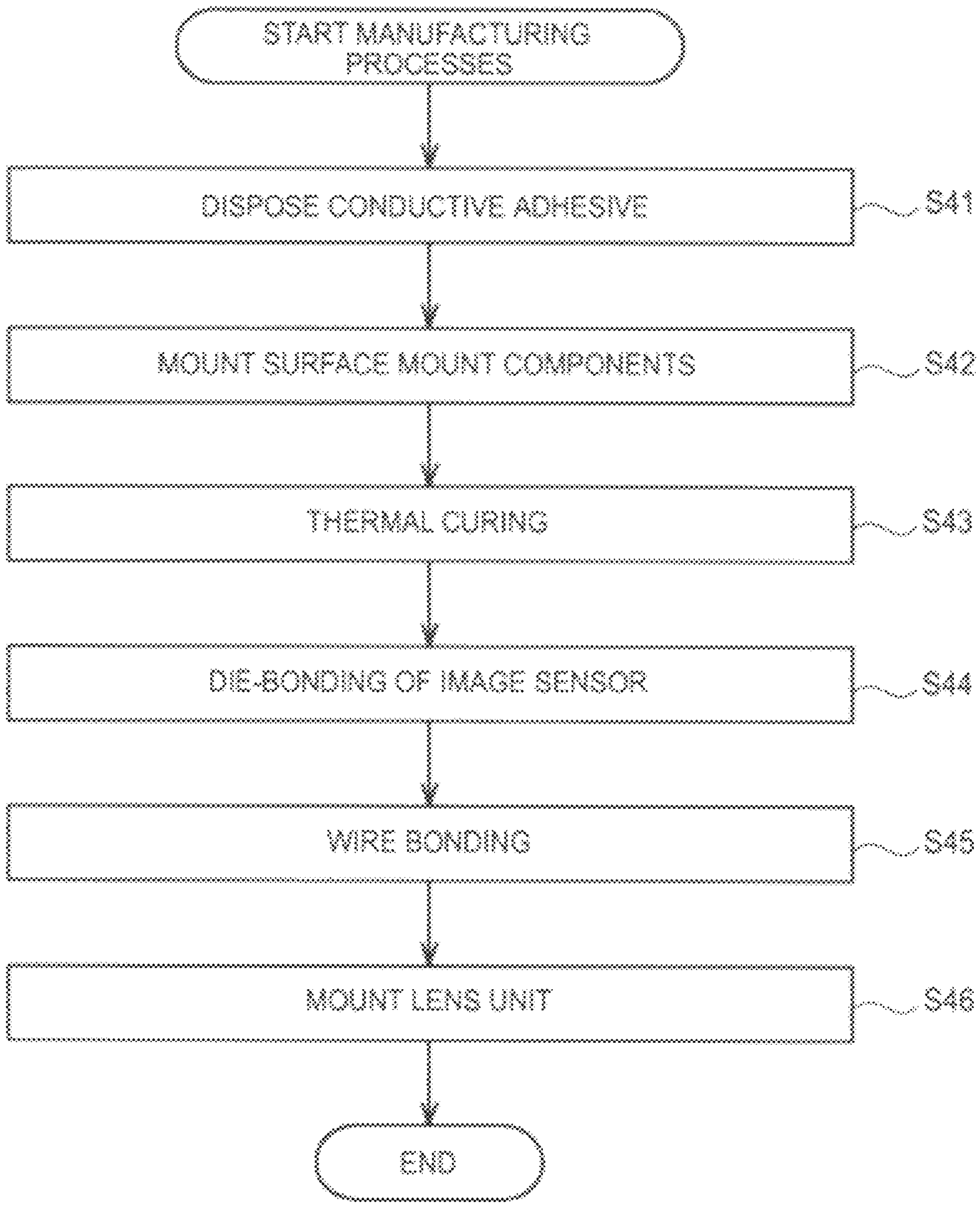


FIG.8


START MANUFACTURING PROCESSES
DISPOSE CONDUCTIVE ADHESIVE
S41
MOUNT SURFACE MOUNT COMPONENTS
S42
THERMAL CURING
S43
DIE-BONDING OF IMAGE SENSOR
S44
WIRE BONDING
S45
MOUNT LENS UNIT
S46
END

SOLID-STATE IMAGING APPARATUS AND METHOD OF MANUFACTURING THE SAME

FIELD

The present disclosure relates to a solid-state imaging apparatus and a method of manufacturing the same. More particularly, the present disclosure relates to a solid-state imaging apparatus in which flare and ghosts can be easily and reliably suppressed and a method of manufacturing such an apparatus.

BACKGROUND

Solid-state imaging apparatus for imaging an object by receiving light from the object are known in the related art. An image sensor forming a part of such a solid-state imaging apparatus has a rectangular light-receiving region, and a light beam entering the image sensor from a lens is projected on a surface of the image sensor in the form of a circular spot including the rectangular light-receiving region.

The light impinges also on external connection terminals disposed around the light-receiving region of the image sensor, and the light further impinges on bonding wires for leading out signals from the external connection terminals. As a result, the light can be reflected by the bonding wires to enter the light-receiving region, and an image obtained by the image sensor may consequently have flare or ghosts which can degrade the quality of the image.

As a result of the recent trend toward smaller image sensor chips, light beams can reach components which are surface-mounted around an image sensor chip. Electrodes of such surface mount components have high reflectance because they are formed by a solder material such as Sn, Ag, or Cu or a conductive adhesive containing conductive particles such as Ag, and flare and ghosts can be generated also as a result of reflection of light at the regions of such electrodes, which also degrades image quality.

Under the circumstance, it is a common practice to prevent unwanted light beams from entering a light-receiving region of an image sensor by disposing a shield member above the light-receiving region. However, according to such a method, it is difficult to suppress flare and ghosts effectively because the shield member and the light-receiving region of the image sensor must be precisely aligned with each other.

Another proposed technique is to prevent stray light by sealing bonding wires for connecting an image sensor and a substrate using a molding material along with cut surfaces of the chip (side surfaces) (See Patent Document 1(JP-A-63-273353)).

SUMMARY

It has not been possible to suppress flare and ghosts sufficiently using the above-described techniques. Specifically, according to the method involving the process of sealing bonding wires with a molding material, bonding wires are looped at a height of about 100 to 200 μm above a top surface of a chip. Therefore, ghosts can be generated as a result of reflection of light impinging on the wires which are located higher than the ship surface.

There is a difference between the linear expansion coefficients of parts of the wires sealed with a molding material and unsealed parts of the wires. Thus, stress concentrates on the parts of the wires at the interface of the sealed parts thereof during a temperature cycle, which can result in

open-circuit failures attributable to deformation or breakage of the wires. Further, the viscosity of a molding material drops immediately before the material begins to thermally set. Therefore, if wires are sealed with the molding material to a seal height which is substantially the same as the height of a chip, the molding material can climb up to a top surface of the chip, and the material can therefore bleed out from the chip surface into a light-receiving region. For this reason, it has been very difficult to control the amount of the molding material to be applied.

The technique described in the present disclosure has been conceived taking such a situation into consideration, and the technique makes it possible to prevent flare and ghosts easily and reliably.

An embodiment of the present disclosure is directed to a solid-state imaging apparatus including an imaging section having a light-receiving portion for receiving light from an object to image the object and a substrate on which the imaging section is disposed, wherein a predetermined member provided on the substrate in the neighborhood of the light-receiving portion is partially or entirely coated in black.

The predetermined member may be coated in black using inkjet printing.

The predetermined member may be a member located in a range on the substrate where the light from the object impinges, and a part of the predetermined member located within the range may be coated in black.

The predetermined member may be a member having reflectance of a predetermined value or higher provided on the substrate, and the predetermined member may be coated in black.

The predetermined member may be a wire connecting the substrate and the imaging section or a packaged component disposed on the substrate.

The embodiment of the present disclosure is also directed to a method of manufacturing a solid-state imaging apparatus, including: disposing an imaging section on a substrate, the imaging section having a light-receiving portion for receiving light from an object to image the object; and partially or entirely coating a predetermined member provided in the neighborhood of the light-receiving portion in black.

According to the embodiment of the present disclosure, an imaging section having a light-receiving portion for receiving light from an object to image the object is disposed on a substrate, and a predetermined member provided in the neighborhood of the light-receiving portion on the substrate is partially or entirely coated in black.

Another embodiment of the present disclosure is directed to a solid-state imaging apparatus including: an imaging section having a light-receiving portion for receiving light from an object to image the object; a substrate on which the imaging section is disposed; and a predetermined member disposed in the neighborhood of the light-receiving portion on the substrate and secured to the substrate with a conductive adhesive which is colored in black by a pigment added therein.

The another embodiment of the present disclosure is also directed to a method of manufacturing a solid-state imaging apparatus, including: disposing a conductive adhesive colored in black by a pigment added therein on a substrate; disposing a predetermined member in the region of the substrate where the conductive adhesive is disposed to connect the predetermined member to the substrate; and disposing an imaging section in the neighborhood of the predetermined member on the substrate, the imaging section having a light-receiving portion for receiving light from an object to image the object.

According to the another embodiment of the present disclosure, the conductive adhesive colored in black by a pigment added therein is disposed on a substrate, the predetermined member is disposed in the region of the substrate where the conductive adhesive is disposed to connect the predetermined member to the substrate, and the imaging section having the light-receiving portion for receiving light from an object to image the object is disposed in the neighborhood of the predetermined member on the substrate.

The another embodiments of the present disclosure make it possible to suppress flare and ghosts more easily and reliably.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration showing an exemplary configuration of an embodiment of a solid-state imaging apparatus according to the present disclosure;

FIG. **2** is an illustration for explaining reflection of light at a bonding wire;

FIG. **3** is an illustration for explaining suppression of reflection achieved by inkjet printing;

FIG. **4** is an illustration for explaining suppression of reflection of light at a bonding wire;

FIG. **5** is a flow chart for explaining processes for manufacturing a solid-state imaging apparatus;

FIG. **6** is illustrations for explaining steps for manufacturing solid-state imaging apparatus;

FIG. **7** is an illustration for explaining inkjet printing; and

FIG. **8** is a flow chart for explaining processes for manufacturing a solid-state imaging apparatus.

DETAILED DESCRIPTION

Embodiments of the present disclosure will now be described with reference to the drawings.

<First Embodiment>

[Exemplary Configuration of Solid-State Imaging Apparatus]

FIG. **1** is an illustration showing an exemplary configuration of an embodiment of a solid-state imaging apparatus according to the present disclosure.

A solid-state imaging apparatus **11** includes a printed circuit board **21**, an image sensor **22**, and surface mount components **23-1** and **23-2**.

The solid-state imaging apparatus **11** is an imaging apparatus which receives light from an object and photo-electrically converts the light to obtain an image of the object. The image sensor **22** and the surface mount components **23-1** and **23-2** are disposed on the printed circuit board **21** forming a part of the solid-state imaging apparatus **11**, and a lens unit (not shown) is disposed on the near side of the printed circuit board **21** with respect to the plane of the drawing.

The image sensor **22** is electrically connected to the printed circuit board **21** by a plurality of bonding wires **31**.

The image sensor **22** includes a light-receiving portion **32** which receives light entering from an object through a lens provided on the lens unit. The sensor performs photoelectric conversion of the light received at the light-receiving portion **32** to convert the received light into an electrical signal in accordance with the amount of light received. The image sensor **22** outputs the electrical signal obtained through photoelectric conversion to a control section provided on the printed circuit board **21** downstream of the sensor through the bonding wires.

The surface mount components **23-1** and **23-2** are passive components such as chip resistors, and the components are surface mount components forming a circuit for driving the solid-state imaging apparatus **11** disposed in the neighborhood of the image sensor **22**. In the example shown in FIG. **1**, the surface mount components **23-1** and **23-2** are disposed in the neighborhood of the image sensor **22**.

Hereinafter, the surface mount components **23-1** and **23-2** may be collectively referred to as “surface mount components **23**” when there is no need for discriminating them from each other.

Light from an object which has impinged on the lens of the lend unit to be collected by the lens is projected on a region R**11** of the printed circuit board **21**. The region R**11** is a circular region including the rectangular light-receiving portion **32** therein. A part of the light which has reached the region R**11** impinges on the light-receiving portion **32**, and the light is converted into an electrical signal representing an image of the object.

As thus described, not all of light beams collected by the lens unit of the solid-state imaging apparatus **11** impinge on the light-receiving portion **32**, and some of the collected light beams are projected on the bonding wires and the surface mount components **23** disposed in the neighborhood of the light-receiving portion **32**.

When the light impinging on the bonding wires and the surface mount components **23** enters the light-receiving portion **32** by being reflected on surfaces of the bonding wires and the surface mount components **23**, flare and ghosts can appear on the resultant image, and the image may therefore have low quality.

For example, let us assume that light from an object impinges on a lens **61** forming a part of the lens unit as shown in FIG. **2** and that light collected by the lens **61** impinges on the bonding wires **31** through an infrared cutoff filter **62** as indicated by dotted lines in FIG. **2**. The dotted lines in FIG. **2** represent optical paths of some beams of light from the object collected by the lens **61**. A feature which is identical between FIGS. **1** and **2** is indicated by the same reference numeral in both figures, and description of such a feature may be omitted in the following if appropriate.

In the example shown in FIG. **2**, since no particular treatment is performed on the bonding wires **31**, the surface of the bonding wires **31** has high reflectance. Therefore, most of light coming from the lens **61** and impinging on the bonding wires **31** is reflected on the surface of the bonding wires **31** to enter the light-receiving portion **32**.

A measure against the problem is taken in the solid-state imaging apparatus **11**. As shown in FIG. **3**, the bonding wires **31** connecting the printed circuit board **21** and the image sensor **22** are coated in black in parts thereof located on the side closer to the light-receiving portion **32**, and the surface of the surface mount components **23** is also coated in black. A feature which is identical between FIGS. **1** and **3** is indicated by the same reference numeral, and description of such a feature may be omitted in the following if appropriate.

Referring to FIG. **3**, the black regions of the bonding wires **31** and the hatched regions of the surface mount components **23** are regions which are coated in black such that they will exhibit low reflectance against light. The black coating serving as a light shield is provided using, light shield printing such as inkjet printing.

For example, the inkjet printing is preferably performed using UV (ultraviolet) ink when the tact time (processing time) of the process and the spread of printed ink is taken into account. However, the present disclosure is not limited to the use of UV ink, and any type of ink may be used as long as it can be easily cured.

Preferably, the inkjet-printed coating is provided on components around the image sensor **22** such as the bonding wires **31** and the surface mount components **23** only in parts of the components on which light from the lens unit impinges or parts of the components included in the region R**11** shown in FIG. **1**.

Alternatively, the coating may be provided on the entire surface of the components (members) in the neighborhood of the image sensor **22** such as the bonding wires **31** and the surface mount components **23** because what is required is to keep the reflectance of parts of the components on which light from the lens unit impinge low. The black coating may alternatively be selectively provided to cover only components having high reflectance or components having reflectance equal to or higher than a predetermined value among components in the neighborhood of the image sensor **22** such as the bonding wires **31**.

When a black coating is provided on the surface of components in the neighborhood of the image sensor **22** as thus described, for example, the reflectance of the surface of the bonding wires **31** is kept lower than the reflectance that the wires have without the coating in parts of the wires on the side thereof closer to the light-receiving portion **32**, as shown in FIG. **4**. A feature which is identical between FIGS. **2** and **4** is indicated by the same reference numeral, and description of such a feature will be omitted if appropriate. In FIG. **4**, the optical paths of some of light beams traveling from the lens **61** and impinging on the bonding wires **31** through the infrared cutoff filter **62** are represented by dotted lines.

In the example shown in FIG. **4**, regions B**11** of the bonding wires **31** on the side of the wires closer to the light-receiving portion **32** are coated with UV ink for shielding the wires from light, and the reflectance of the bonding wires **31** is lower in the regions B**11** than in other regions thereof. As a result, reflection of light coming from the lens **61** and impinging on the regions B**11** is suppressed, and only a small part of the light from the lens **61** is reflected to impinge on the light-receiving portion **32**.

As thus described, when components in the neighborhood of the image sensor **22** such as the bonding wires **31** are coated in black using a light shield printing process, reflection of light can be suppressed at coated parts to prevent unnecessary light from impinging on the image sensor **22**. As a result, flare and ghosts can be simply and reliably suppressed to obtain an image of high quality.

For example, when the components in the neighborhood of the image sensor **22** are coated using a light shield printing process, desired parts of the components can be selectively coated, which is advantageous than sealing the bonding wires with a molding material in that flare and ghosts can be more reliably suppressed at a lower cost. It is advantageous to coat the bonding wires and the like using light shield printing also in that a compact image sensor chip can be obtained because coated regions occupy a space smaller than a space required for sealing the wires with a molding material.

Further, the solid-state imaging apparatus **11** does not need to have a member such as a shield plate for shielding components in the vicinity of the image sensor **22** from light coming from the lens unit. Therefore, flare and ghosts can be sufficiently suppressed without relying on the precision of assembly of components forming the solid-state imaging apparatus **11**.

[Manufacture of Solid-State Imaging Apparatus]

Processes for manufacturing the solid-state imaging apparatus **11** shown in FIG. **1** will now be described with reference to the flow chart shown in FIG. **5**.

At step S**11**, surface mount components are mounted on an aggregate board formed by a plurality of printed circuit boards.

For example, an aggregate board **91** formed by a plurality of printed circuit boards including a printed circuit board **21** is provided as indicated by an arrow M**11** in FIG. **6**. Required surface mount components are disposed and secured on each of the printed circuit boards forming the aggregate board **91** as indicated by an arrow M**12**. A feature which is identical between FIG. **6** and FIG. **1** or **4** is indicated by the same reference numeral, and description of such a feature may be omitted if appropriate.

For example, the bottom right part of the aggregate board **91** indicated by the arrow M**12** is a printed circuit board **21**, and surface mount components **23-1** and **23-2** are disposed and secured on the printed circuit board **21**.

When surface mount components are mounted on the aggregate board **91** as thus described, the printed circuit boards forming the aggregate board **91** are separated from each other, and the printed circuit boards are thereafter processed to manufacture solid-state imaging apparatus.

Referring to the flow chart in FIG. **5** again, an image sensor **22** is die-bonded onto the printed circuit board **21** at step S**12**. For example, the image sensor **22** is disposed on the printed circuit board **21** as indicated by an arrow M**13** in FIG. **6**, and the image sensor **22** is secured on the printed circuit board **21** using an adhesive.

At step S**13**, wire bonding is performed between the printed circuit board **21** and the image sensor **22**. For example, the printed circuit board **21** and the image sensor **22** are electrically connected by a plurality of bonding wires **31** as indicated by an arrow M**14** in FIG. **6**. More specifically, terminals of the image sensor **22** and pads provided at ends of signal lines on the printed circuit board **21** are connected by the bonding wires **31**.

At step S**14**, light shield printing (inkjet printing) is performed on the bonding wires connected to the image sensor **22**. For example, UV ink is selectively inkjet-printed and cured on parts of the wires which are included in a region R**11** as shown in FIG. **1** or parts of the wires on which light from an object impinges, among the bonding wires connected to the image sensor **22** such as the bonding wires **31**. Thus, the printed regions of the bonding wires are coated with UV ink.

At step S**15**, light shield printing is performed on the surface mount components **23**. For example, UV ink is selectively inkjet-printed and cured on parts of the surface mount components **23** which are included in the region R**11** as shown in FIG. **1** or parts of the components which have high reflectance.

As a result of the processes at steps S**14** and S**15**, for example, parts of the bonding wires **31** on the printed circuit board **21** and the entire surface of the surface mount components **23** are coated with UV ink as indicated by an arrow M**15** in FIG. **6**. In FIG. **6**, the black parts of the bonding wires **31** and the hatched parts of the surface mount components **23** are coated parts.

Referring to the flow chart shown in FIG. **5** again, a lens unit is mounted on the printed circuit board **21** to form a solid-state imaging apparatus **11** at step S**16**, and the series of manufacturing processes terminates.

For example, as indicated by an arrow M**16** in FIG. **6**, a lens unit **92** having a lens **61** is disposed on the print circuit board **21** such that components including the image sensor **22** will be covered, and the unit is secured to the printed circuit board **21**. Thus, an apparatus including a lens unit **92** and a printed circuit board **21** is provided as a solid-state imaging apparatus **11**.

More specifically, light shield printing (inkjet printing) at steps S**14** and S**15** is carried out, for example, by applying (printing) and curing UV ink on the members around the image sensor **22** repeatedly as shown in FIG. **7**. A feature which is identical between FIGS. **1** and **7** is indicated by the same reference numeral, and description of such a feature may be omitted as occasion demands.

In the example shown in FIG. **7**, an inkjet head **121** which is located above the printed circuit board **21** in the illustration ejects UV ink while reciprocating to the left and right to apply UV ink to desired positions of the bonding wires **31** and the like. Thus, UV ink is applied to (printed on) the black regions of the bonding wires.

After the inkjet head **121** ejects UV ink, the UV ink is cured by UV lamps **122-1** and **122-2** which are provided on left and right ends of the inkjet head **121** in FIG. **7**. That is, the UV lamps **122-1** and **122-2** irradiate the parts of the bonding wires having the UV ink applied thereon with ultraviolet light to cure the UV ink.

Inkjet printing is carried out by the inkjet head **121** which ejects and cures UV ink repeatedly while moving to the left and right in illustration as described above. After inkjet printing is performed on the bonding wires such as the bonding wires **31**, inkjet printing is similarly performed on the surface mount components **23**.

When UV ink is used as the inkjet material for the inkjet printing process, a reduction in the yield of solid-state imaging apparatus **11** attributable to bleeding out of the ink material can be prevented because the material can be quickly cured.

As thus described, flare and ghosts can be easily and reliably suppressed by providing a black coating on members around the image sensor **22**.

[Modification]

In the above description, members around the image sensor **22** are coated using inkjet printing, a black resin may alternatively be applied to the bonding wires and the surface mount components **23** when there is a sufficient distance between the light-receiving portion **32** and the bonding wires **31**. That is, protection may be provided by sealing the components with a liquid material.

When a black resin is applied to the bonding wires **31** and the surface mount components **23** using a dispenser or the like as thus described, reflection of light impinging on the surface of the bonding wires **31** and the surface mount components **23** from the lens **61** can be suppressed by the black resin. Thus, generation of flare and ghosts can be suppressed to prevent degradation of the quality of an image.

When a black resin is to be applied using a dispenser, in order to prevent a chip on the printed circuit board **21** from being contaminated as a result of bleeding out of the black resin after the application of the resin, it is preferable to impart UV curability to the resin to allow the resin to be cured immediately after being applied to a surface. In this case, it is preferable to perform preliminary curing of the resin and to perform thermal curing thereafter to cure the resin completely.

Further, when a black resin is applied to the bonding wires **31** using a dispenser, voids (bubbles) are likely to be generated in the resin applied in the gap the between the bonding wires **31** and the image sensor **22**. In order to suppress the generation of voids, it is desirable to perform wire bonding such that the wires are looped with a loop height as small as about 30 to 70 μm.

<Second Embodiment>

[Manufacture of Solid-State Imaging Apparatus]

When surface mount components **23** are mounted on a printed circuit board **21**, the surface mount components **23** may be secured to the board using a conductive adhesive which is colored in black. Manufacturing processes performed in such a case will be described below with reference to the flow chart in FIG. **8**.

At step S**41**, a conductive adhesive colored in black using carbon black is dispensed or printed on (applied to) connection lands of the printed circuit board **21** for connecting the surface mount components **23** to the board.

At step S**42**, the surface mount components **23** are mounted on the printed circuit board **21** in the positions where the conductive adhesive has been disposed. More specifically, for example, electrode portions of the surface mount components **23** may be disposed on the connection lands of the printed circuit board **21**.

At step S**43**, thermal curing is performed on the conductive adhesive. As a result, the conductive adhesive is cured to secure the surface mount components **23** on the printed circuit board **21** and to electrically connect the printed circuit board **21** and the surface mount components **23**.

At step S**44**, an image sensor **22** is die-bonded onto the printed circuit board **21**. For example, the image sensor **22** is secured to the printed circuit board **21** using an adhesive. Further, wire bonding is carried out between the printed circuit board **21** and the image sensor **22** at step S**45**.

At step S**46**, a lens unit **92** is mounted on the printed circuit board **21** to form a solid-state imaging apparatus **11**, and the series of manufacturing processes is terminated.

When a solid-state imaging apparatus **11** is manufactured as described above, the parts connecting the printed circuit board **21** and the surface mount components **23** and lateral parts of the surface mount components **23** are covered by the black conductive adhesive. Since the reflectance of such a conductive adhesive is normally lower than the reflectance of solder used for securing the surface mount components **23**, even when light from a lens **61** impinges on the conductive adhesive applied to the parts for connecting the surface mount components **23**, the reflection of light can be suppressed. As a result, it is possible to prevent unwanted light from impinging on a light-receiving portion **32**, and flare and ghosts can therefore be sufficiently suppressed.

Any type of conductive adhesive may be used for mounting the surface mount components **23** as long as it is a conductive material colored in black by adding a pigment such as carbon black.

The present disclosure is not limited to the above-described embodiments, and various modifications may be made without departing from the spirit of the present disclosure.

The present disclosure contains subject matter related to that disclosed in Japanese Priority Patent Application JP 2011-033687 filed in the Japan Patent Office on Feb. 18, 2011, the entire content of which is hereby incorporated by reference.

It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. A solid-state imaging apparatus comprising:

an imaging section having a light-receiving portion configured to receive light from an object to image the object;

a substrate on which the imaging section is disposed; and

one or more bonding wires, connecting the substrate and the imaging section, located in a range on the substrate where light from the object impinges,

wherein the one or more bonding wires are partially or entirely coated with black ink.

2. The solid-state imaging apparatus according to claim **1**, wherein the one or more bonding wires are coated with the black ink using inkjet printing.

3. The solid-state imaging apparatus according to claim **1**, wherein the one or more bonding wires have a reflectance of a predetermined value or higher.

4. The solid-state imaging apparatus according to claim **1**, further comprising a packaged component disposed on the substrate in the neighborhood of the light receiving portion.

5. The solid-state imaging apparatus according to claim **1**, further comprising a packaged component, wherein the package component comprising one or more chip resistors disposed on the substrate where light from the object impinges.

6. The solid-state imaging apparatus according to claim **5**, wherein the one or more chip resistors disposed on the substrate are partially or entirely coated with the black ink.

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